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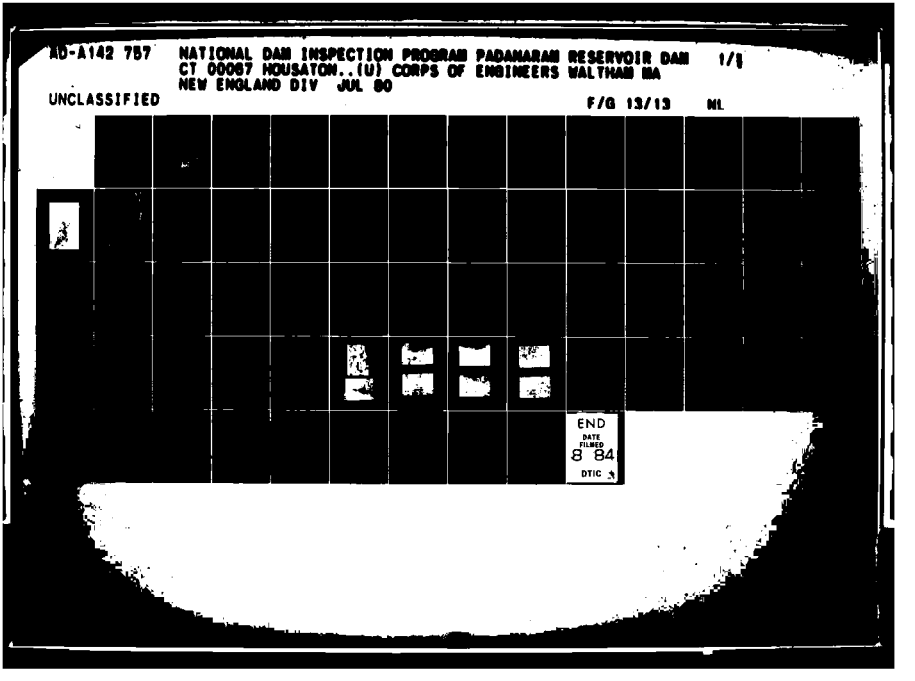

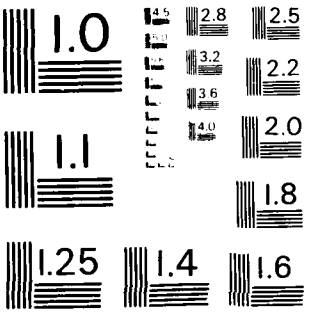

HOUSATONIC RIVER BASIN

DANBURY CONNECTICUT

PADANARAM RESERVOIR DAM
CT 00067

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Housatonic River Basin
Danbury Conn.
Padanaram Reservoir Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Padanaram Reservoir is an earth embankment with a stone masonry faced downstream slope that is approx. 325 ft. long and 26.3 ft. high. The downstream stone face is on a 1:12 slope and the upstream earth embankment is on a 2.25:1 slope. The spillway is located at the southern abutment of the dam and is 24-foot long channel. There is a lower gate house in the center of the dam for the control of a discharge pipe that passes through the base of the dam. The size of the discharge pipe is unknown and the valve for its operation is inoperable. The drainage area is 3.7 square miles and the reservoir has 52 acre-feet of available storage.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED-E

SEP

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Padanaram Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Padanaram Reservoir Dam would likely be exceeded by floods greater than 8 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as that term would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy precipitation, round-the-clock surveillance should be provided.

NEDED-E
Honorable Ella T. Grasso

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. This report has also been furnished to the owner of the project, Mr. John A. Schweitzer, Jr., City Engineer, City of Danbury, Danbury, Connecticut 06810.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act, thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for the cooperation extended in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

PADANARAM RESERVOIR DAM

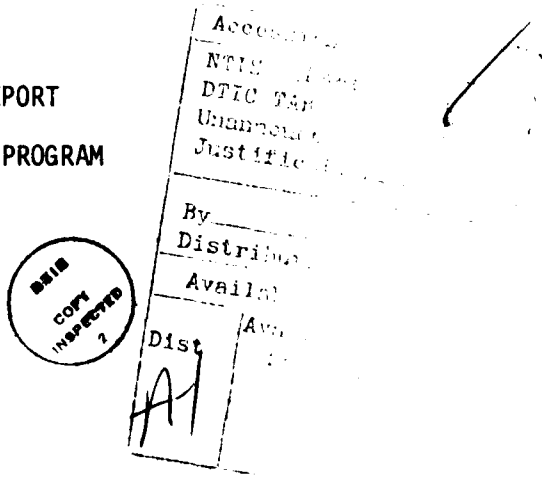
CT 00067

HOUSATONIC RIVER BASIN

DANBURY, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification Number:	CT 00067
Name:	Padanaram Reservoir Dam
Town:	Danbury
County and State:	Fairfield County, Connecticut
Stream:	Padanaram Brook
Date of Inspection:	April 21, 1980

BRIEF ASSESSMENT

The Padanaram Reservoir Dam is an earth embankment with a stone masonry faced downstream slope that is approximately 325 feet long and 26.3 feet high. The downstream stone face is on a 1:12 slope and the upstream earth embankment is on a 2.25:1 slope. The spillway is located at the southern abutment of the dam and is 24-foot long channel. There is a lower gate house in the center of the dam for the control of a discharge pipe that passes through the base of the dam. The size of the discharge pipe is unknown and the valve for its operation is inoperable. The drainage area is 3.7 square miles and the reservoir has 52 acre-feet of available storage.

The assessment of the dam is based on the visual inspection, past operational performance and hydraulic/hydrologic computations. The dam is judged to be in fair condition with several areas that require attention. These areas include seepage through the dam and along the toe, vegetation on the stone face and along the toe of the dam and the nonoperating status of the blowoff.

The dam is classified as small and has a high hazard potential in accordance with guidelines established by the Corps of Engineers. The test flood for this dam is 1/2 the Probable Maximum Flood (PMF). The test flood inflow is 3,608 cfs and the routed test flood outflow is 3,460 cfs. The test flood outflow will overtop the dam by 2.3 feet.

It is recommended that the owner engage the services of a qualified registered engineer experienced in the design of dams to investigate the seepage through the dam and prepare a detailed hydraulic/hydrologic study to determine the spillway's adequacy.

Additional recommendations and remedial measures are included in Section 7 and should be implemented within one year after receipt of this Phase I Inspection Report.

Joseph F. Merluzzo
Connecticut P.E. #7639
Project Manager

Gary J. Giroux
Connecticut P.E. #11477
Project Engineer

This Phase I Inspection Report on Padanaram Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Inspections. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Inspection; however, the investigation is intended to identify any need for such studies.

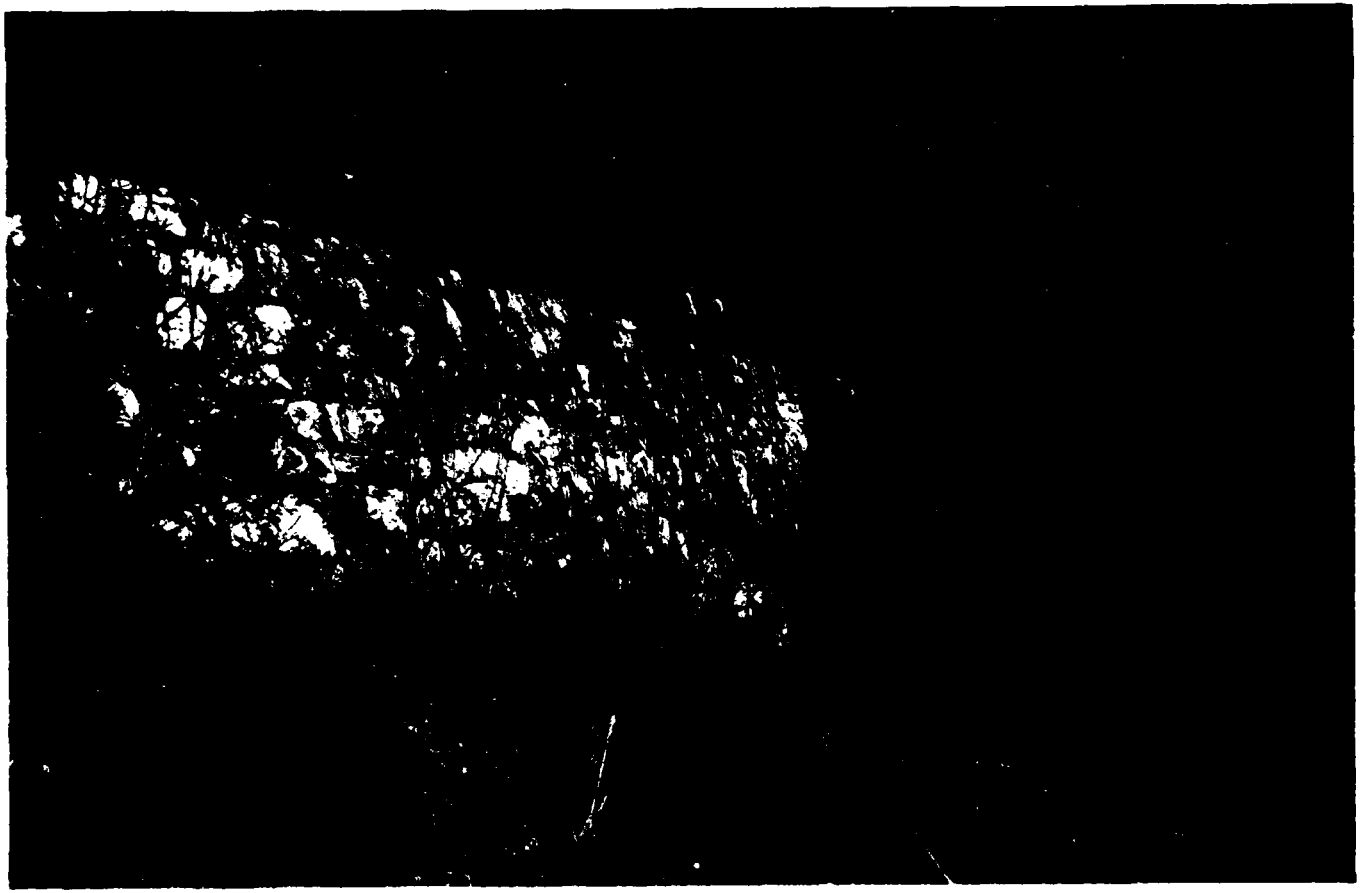
In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

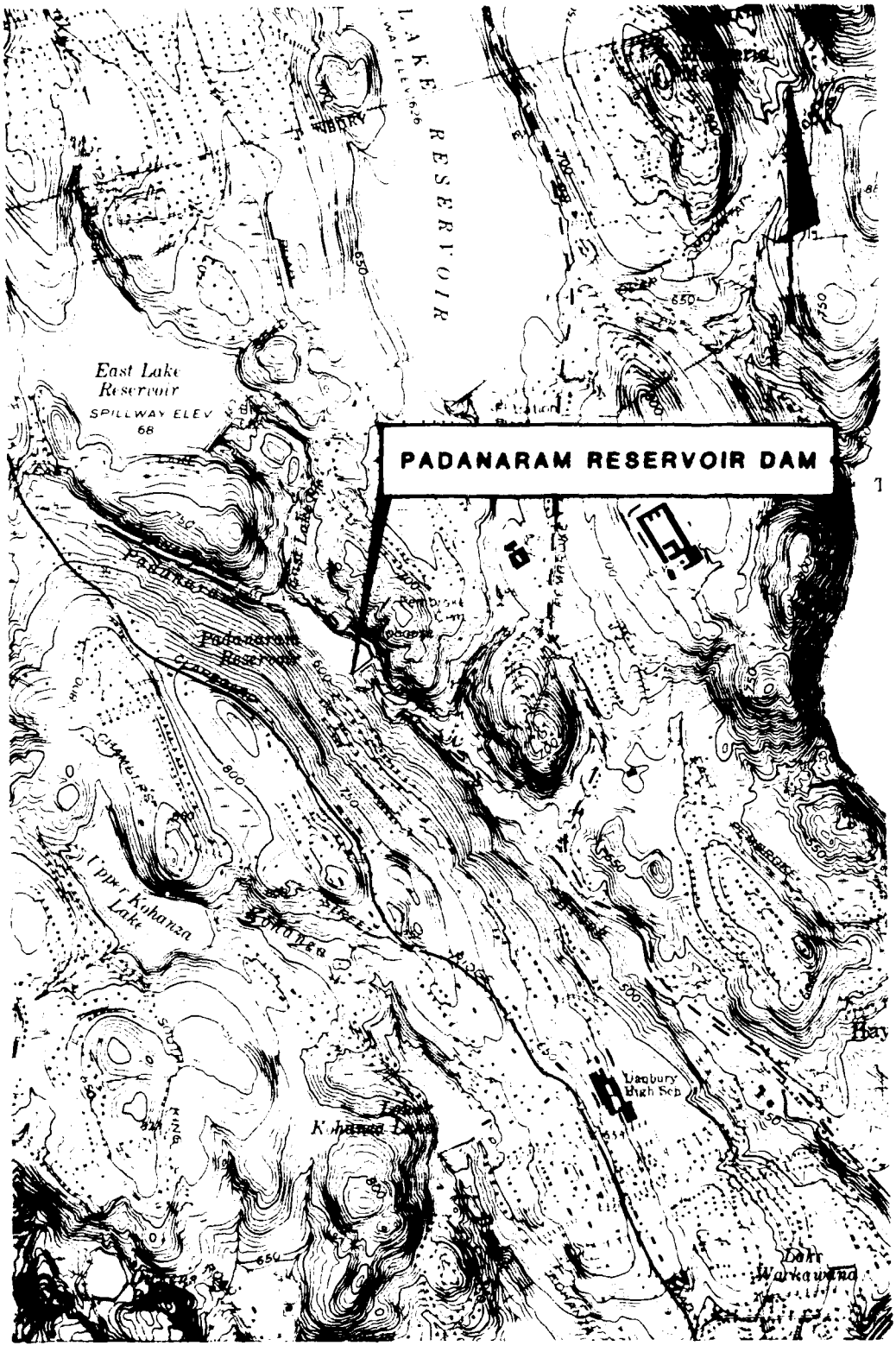
Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Test Flood is based on the estimated Probable Maximum Flood for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and variety of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Inspection does not include an assessment of the need for fences, gates, "no trespassing" signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with Occupational Safety and Hazard Administration's (OSHA) rules and regulations is also excluded.

TABLE OF CONTENTS



PADANARAM RESERVOIR DAM



QUADRANGLE **DANBURY, CT**

US ARMY, CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASS.

SCALE IN FEET
2000' 0 2000' 4000'
1" = 2000'

LOCATION MAP

PHASE I INSPECTION REPORT

PADANARAM RESERVOIR DAM CT 00067

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspections throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Storch Engineers has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Storch Engineers under a letter of March 6, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0035 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection -

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location - The Padanaram Reservoir Dam is located approximately 3 miles northwest of downtown Danbury and 3,700 feet north of the intersection of

Padanaram Road and Pembroke Road in the City of Danbury, Connecticut (See Location Map). The coordinates of the dam are approximately 41°-26' north latitude and 73°-29' west longitude. The dam is located on Padanaram Brook in the Housatonic River Basin.

b. Description of Dam and Appurtenances - The Padanaram Reservoir Dam is an earth embankment with a stone faced downstream slope that is 325 feet long and 26.3 feet high. The downstream stone face is on a 1:12 slope and the upstream earth embankment is on a 2.25:1 slope. The top of the dam is capped with concrete, 7 feet wide. The upstream embankment is lined with riprap.

The spillway is located through the southern abutment of the dam and consists of a 24-foot long stone weir and a 24-foot wide downstream spillway channel.

There is a lower gate house at the center of the dam with a valve that controls a discharge pipe that passes through the base of the dam. The size of the pipe is unknown. The valve in the gate house is not operable.

c. Size Classification - The Padanaram Reservoir Dam has a maximum height of 26.3 feet and a maximum storage of 132.5 acre-feet at the top of the dam. In accordance with the Recommended Guidelines for Safety Inspection of Dams established by the Corps of Engineers, the dam is classified as small (height less then 40 feet and storage less than 1,000 acre-feet).

d. Hazard Classification - The Padanaram Reservoir Dam is classified as having a high hazard potential. Failure of the dam could result in the loss of more than a few lives. Approximately 1,500 feet downstream are two homes which would be inundated by the flood wave. Estimated flow and water depths just prior to dam failure at this location is 600 cfs at 2 feet and just after dam failure is 12,000 cfs at 11 feet or an increase in depth of 9 feet.

e. Ownership - The Padanaram Reservoir Dam is owned by the City of Danbury, Connecticut.

f. Operator - The person in charge of day-to-day operation of the dam is:

Mr. John A. Schweitzer, Jr.
City Engineer
City of Danbury
Danbury, Connecticut 06810
(203) 797-4641

g. Purpose of Dam - The dam impounds the Padanaram Reservoir which serves as a water supply for the City of Danbury.

h. Design and Construction History - There are no design computations or construction drawings. The Padanaram Reservoir Dam was constructed in 1882.

i. Normal Operational Procedure - There are no operational procedures for the dam. Water impounded by the dam is used only in times of shortage.

1.3 Pertinent Data

a. Drainage Area - The Padanaram Reservoir drainage basin is in the City of Danbury and is irregular in shape. The area of the drainage basin is 3.7 square miles (Appendix D - Plate 3). Approximately 5 percent of the drainage basin is natural storage and more than 60 percent is developed. The topography is rolling with elevations ranging from 1,023 (NGVD) to 577 (NGVD) at the spillway crest. Approximately 45% of the watershed is controlled by East Lake Reservoir, another water supply reservoir.

b. Discharge at Damsite - There are no records available for discharge at the dam.

(1)	Outlet works (conduit) size:	unknown
	Invert elevation (feet above NGVD):	unknown
	Discharge Capacity at top of dam:	unknown
(2)	Maximum known flood at damsite:	unknown

(3)	Ungated spillway capacity at top of dam:	600 cfs
	Elevation (NGVD):	581.3
(4)	Ungated spillway capacity at test flood elevation:	1,050 cfs
	Elevation (NGVD):	583.6
(5)	Gated spillway capacity at normal pool elevation:	N/A
	Elevation (NGVD):	N/A
(6)	Gated spillway capacity at test flood elevation:	N/A
	Elevation:	N/A
(7)	Total spillway capacity at test flood elevation:	1,050 cfs
	Elevation (NGVD):	583.6
(8)	Total project discharge at top of dam:	600
	Elevation (NGVD):	581.3
(9)	Total project discharge at test flood elevation:	3,460 cfs
	Elevation (NGVD):	503.6

c. Elevation (feet above NGVD)

(1)	Streambed at toe of dam:	555
(2)	Bottom of cutoff:	unknown
(3)	Maximum tailwater:	560
(4)	Normal pool:	577
(5)	Full flood control pool:	N/A
(6)	Spillway crest (ungated):	577

(7)	Design surcharge (original design):	unknown
(8)	Top of dam:	581.3
(9)	Test flood surcharge:	583.6
d.	Reservoir (length in feet)	
(1)	Normal pool:	1,200
(2)	Flood control pool:	N/A
(3)	Spillway crest pool:	1,200
(4)	Top of dam:	1,250
(5)	Test flood pool:	1,300
e.	Storage (acre-feet)	
(1)	Normal pool:	80.5
(2)	Flood control pool:	N/A
(3)	Spillway crest pool:	80.5
(4)	Top of dam:	132.5
(5)	Test flood pool:	159.5
f.	Reservoir Surface (acres)	
(1)	Normal pool:	9.18
(2)	Flood control pool:	N/A
(3)	Spillway crest:	9.18
(4)	Test flood pool:	13.5
(5)	Top of dam:	12
g.	Dam	
(1)	Type:	earth embankment/stone masonry downstream face
(2)	Length:	325 feet
(3)	Height:	26.3 feet

(4)	Top width:	7 feet
(5)	Side slopes:	U/S - 2.25:1 D/S - 1:12
(6)	Zoning:	unknown
(7)	Impervious core:	unknown
(8)	Cutoff:	unknown
(9)	Grout curtain:	unknown
(10)	Other:	N/A
h.	Diversion and Regulating Tunnel	N/A
i.	Spillway	
(1)	Type:	stone-broad crested
(2)	Length of weir:	24 feet
(3)	Crest elevation (without flashboard):	577
(4)	Gates:	N/A
(5)	U/S channel:	riprapped pond bottom
(6)	D/S channel:	24-foot riprapped and natural channel
(7)	General:	N/A
j.	Regulating Outlets	
(1)	Invert elevation (NGVD):	unknown
(2)	Size:	unknown
(3)	Description:	unknown
(4)	Control Mechanism	manually operated gate
(5)	Other:	gate not operable

SECTION 2 - ENGINEERING DATA

2.1 Design Data

There are no design computations or drawings available. The dam was designed by W. G. Worthington and D. G. Penfield, Engineers.

2.2 Construction Data

The dam was constructed in 1882 by George McKee, Contractors. There are no records or drawings available for the construction of the dam.

2.3 Operation Data

There are no operations at this dam. Water is pumped out during times of shortages. There is a discharge pipe but it is not operating.

2.4 Evaluation of Data

a. Availability - There were no computations or drawings available. There are no operating procedures.

b. Adequacy - The information made available along with the visual inspection, past performance history and hydraulic/hydrologic assumptions were adequate to assess the condition of the facility.

c. Validity - Due to the lack of available data, the conclusions and recommendations found in this report are based on the visual inspection and hydraulic/hydrologic computations.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General - The visual inspection was conducted on April 21, 1980 by members of the engineering staff of Storch Engineers, D. Baugh and Associates, Inc. and Matthews Associates with the help of Mr. Bruce Healy of the City of Danbury, Connecticut. A copy of the visual inspection check list is contained in Appendix A of this report. Selected photos of the dam and appurtenant structures are contained in Appendix C.

In general, the overall appearance and condition of the facility and its appurtenant structures is fair.

b. Dam - The dam is an earth embankment with a stone masonry faced downstream slope. The downstream face of the dam needs repointing in areas where vegetation has been growing from the joints (Photo 1). There appears to be a bulge in the masonry just to the east of the gate house. A closer look at this bulge, however, does not show any distress in the mortared joints. The alignment of the top of the dam is good (Photo 2) and no bulges are apparent. The upstream embankment is brush covered and there are areas where the riprap has moved (Photo 2). The top of the dam is level with no signs of settlement. The stone wingwall is in good condition.

Just below the toe of the dam and to the east of the gate house, there is a steady seepage flow (Photos 7 and 8) which was estimated to be approximately 50 to 75 gallons per minute. This seepage is clear and does not show any signs of particle movement. The estimated quantity of flow is from the entire area as shown on the Photo Location Plan.

c. Appurtenant Structures - The lower gate house (Photo 6) is structurally sound, however, the valve is not operating and the type and size of the discharge pipe is unknown. The discharge pipe outlets approximately 50 feet downstream and is silted-up and has not experienced flow in years.

The spillway is a stone weir that is in fair condition (Photo 3). The approach channel is not well defined and is the natural slope of the bottom of the pond. The training walls of the spillway are also stone masonry and are in fair condition. The downstream channel is a natural channel with riprap in some areas. It is 24 feet wide with steep side slopes (Photo 4). The condition is good except for areas of the channel were debris is cluttered.

d. Reservoir Area - The area immediately adjacent to the facility is steeply sloped and in a natural state. The shoreline shows no signs of sloughing or erosion and there is no development adjacent to the reservoir. A rapid rise in the water level of the reservoir will not endanger any life or property.

e. Downstream Channel - The downstream channel is a natural channel lined with rock and rock outcroppings.

3.2 Evaluation

Overall, the general condition of the dam is fair. The visual inspection revealed items that lead to this assessment, and apparent areas of distress such as:

a. Seepage from the toe.

b. Inoperation of the blowoff.

c. Vegetation on the downstream face along the toe of the dam and the downstream channel.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General - The operation of this facility is for water supply purposes and the reservoir is kept as full as possible. The discharge pipe through the dam cannot be controlled because the valve is frozen shut and is inoperable.

b. Description of any Warning System in Effect - There is no warning system in effect for this dam.

4.2 Maintenance Procedures

a. General - This dam is minimumly maintained.

b. Operating Facilities - Valve to the discharge pipe is not operable.

4.3 Evaluation

The maintenance of the dam is less than adequate in that proper care of the dam embankment should be on a regular basis. The valve to the discharge pipe should be maintained in working order and there should be a proper operating procedure and warning system in effect.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Padanaram Reservoir Dam is an earth embankment with a stone masonry faced downstream slope approximately 325 feet long and 26.3 feet high. The spillway is a stone weir, 24 feet long. The downstream channel is 24 feet wide and is natural ground with some riprap. A discharge pipe passes through the base of the dam. The size of the pipe is not known and the valve is inoperable.

The watershed encompasses 3.7 square miles and is more than 60 percent developed. The topography is rolling with the terrain rising 446 feet from the spillway crest.

The pond has a total capacity of 132.5 acre-feet when the pond is at the top of the dam and 80.5 acre-feet at the spillway crest. Therefore, there is approximately 32 acre-feet of storage available. The test flood outflow for this dam is 3,460 cfs and the spillway capacity is 600 cfs or approximately 17% of the test flood outflow.

5.2 Design Data

No design data is available.

5.3 Experience Data

The Padanaram Reservoir Dam has experienced all the major storms of the 1930's and 1950's and most recently January, 1979. The flood of record in the Danbury area resulted from the storm of October, 1955.

5.4 Test Flood Analysis

Based on the guidelines found in the Recommended Guidelines for Safety Inspection of Dams, the dam is classified as small structure with a high hazard

potential. The test flood for these conditions ranges from 1/2 the Probable Maximum Flood (PMF) to the PMF. One half the PMF was used for this dam because of its size.

Using the guide curves established by the Corps of Engineers (rolling terrain), the test flood inflow is 3,608 cfs. The routing procedure established by the Corps gives an approximate outflow of 3,460 cfs. The spillway capacity is approximately 600 cfs or approximately 17% of the test flood outflow. The test flood will overtop the dam by approximately 2.3 feet.

In the development of the test flood inflow, it was assumed that the East Lake Reservoir Dam had no effect on the peak inflow. Although it does, the actual amount is negligible. This simplified the development of the inflow hydrograph, the routing through the dam and the outflow hydrograph for Padanaram Reservoir Dam.

Storage behind the dam was assumed to begin at the elevation of the spillway crest. Storage was determined by an average area depth analysis. Capacity curves for the spillway assumed weir flow.

5.5 Dam Failure Analysis

A dam failure analysis was performed using the Rule of Thumb method in accordance with guidelines established by the Corps of Engineers. Failure was assumed to occur when the water level in the reservoir was at the top of the dam.

The spillway discharge just prior to dam failure is 600 cfs and will produce a depth of flow of approximately 2 feet several hundred feet downstream from the dam. The calculated dam failure discharge is 19,050 cfs and will produce a depth of flow of approximately 10 feet several hundred feet downstream from the dam or an increase in water depth at failure of approximately 8 feet. The failure

analysis covered a distance of approximately 4,700 feet downstream where the depth of flow was calculated to be 4.5 feet or an increase of approximately 2.5 feet.

Failure of the Padanaram Reservoir Dam may result in the loss of more than a few lives and may damage at least two dwellings located approximately 1,500 feet downstream. Flow due to failure at this location will be approximately 12,000 cfs at a depth of 11 feet.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The general structural stability of the dam is good as evidenced by the vertical, horizontal and lateral alignment of the face and top of the dam and by the age of the dam. A bulge was noted on the front face of the dam east of the centerline, extending about 1/4 of the length. This bulge, however, appears to have originated during construction because no cracking of the masonry or mortar was observed. Some joints in the masonry need repointing as evidenced by the vegetative growth from the joints.

The spillway channel is in fair condition. It should be cleared of the accumulated debris and some of the stones realigned.

Some possible problem areas are seepage at the toe of the dam and the cluttered spillway.

6.2 Design and Construction Data

No design data or construction drawings are available.

6.3 Post-Construction Changes

No information on post-construction changes are available.

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and in accordance with Recommended Phase I Guidelines does not warrant a seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - After consideration of the available information, the results of the inspection and hydraulic/hydrologic computations, the general condition of the Padanaram Reservoir Dam is fair.

b. Adequacy of Information - The information available is such that an assessment of the safety of the dam should be based on available data, the visual inspection results, past operational performance of the dam and its appurtenant structures and computations developed for this report.

c. Urgency - It is considered that the recommendations suggested below be implemented within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

The following recommendations should be carried out under the direction of a qualified registered engineer.

a. Seepage through the dam and at the toe of the dam should be investigated further to determine its origin and monitored to determine any changes.

b. Prepare a detailed hydraulic/hydrologic study to determine spillway adequacy and an increase of the total project discharge if necessary.

c. Trees including stumps and root systems should be removed from the toe and embankment slopes and backfilled with proper material.

7.3 Remedial Measures

a. Operation and Maintenance Procedures -

(1) Spillway channel should be cleared of debris and relined with the stone available.

(2) Vegetation on the downstream face of the dam and trees along the toe of the dam should be removed. This will facilitate the visual observation of existing and potential seepage.

(3) Discharge valve and pipe should be repaired. Valve for the discharge pipe should be on the upstream side of the embankment.

(4) Plans for a regular program of operation and maintenance of the dam should be initiated.

(5) Plans for around-the-clock surveillance should be developed for periods of unusually heavy rains and a formal downstream warning system should be put into operation for use in the event of an emergency.

(6) A program of annual technical inspection should be established.

7.4 Alternatives

None.

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT PADANARAM RESERVOIR DAM

DATE 4/21/80

TIME 11:00 a.m.

WEATHER Clear

W.S. ELEV._____ U.S.____ DN.S.

PARTY:

1. John F. Schearer, SE Civil
2. John Pozzato, MA Mech.
3. Kenneth J. Pudeler, SE Civil
4. Gary J. Giroux, SE Hyd/Civil
5. Michael Haire, SE Struct/Geo.
6. Peter Austin, DBA Civil
7. Bruce Healy, Danbury
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	Good
Current Pool Elevation	Fair to good/some erosion
Maximum Impoundment to Date	No information available
Surface Cracks	Minor
Pavement Condition	Good
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	Problem
Vegitation on Slopes	Some through joints - minor
Sloughing or Erosion of Slopes or Abutments	Upstream - some/minor
Rock Slope Protection - Riprap Failures	Minor upstream
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Negligable through dam - some below dam.
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Underwater
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural Stone masonry	
General Condition	Fair
Condition of Joints	Fair
Spalling	N/A
Visible Reinforcing	N/A
Rusting or Staining of Concrete	N/A
Any Seepage or Efflorescence	Minor
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	N/A
Cracks	N/A
Rusting or Corrosion of Steel	N/A
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	None
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	None

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Inaccessable
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	N/A
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	N/A
Visible Reinforcing	N/A
Any Seepage or Efflorescence	N/A
Condition at Joints	N/A
Drain holes	N/A
Channel	Not well defined
Loose Rock or Trees Overhanging Channel	Brush and trees in channel
Condition of Discharge Channel	Fair

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Underwater
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	Dry rubble
General Condition of Concrete	Fair
Rust or Staining	N/A
Spalling	N/A
Any Visible Reinforcing	N/A
Any Seepage or Efflorescence	N/A
Drain Holes	N/A
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	Some
Trees Overhanging Channel	Some
Floor of Channel	Natural rock - good
Other Obstructions	None

INSPECTION CHECK LIST

PROJECT PADANARAM RESERVOIR DAM DATE 4/21/80

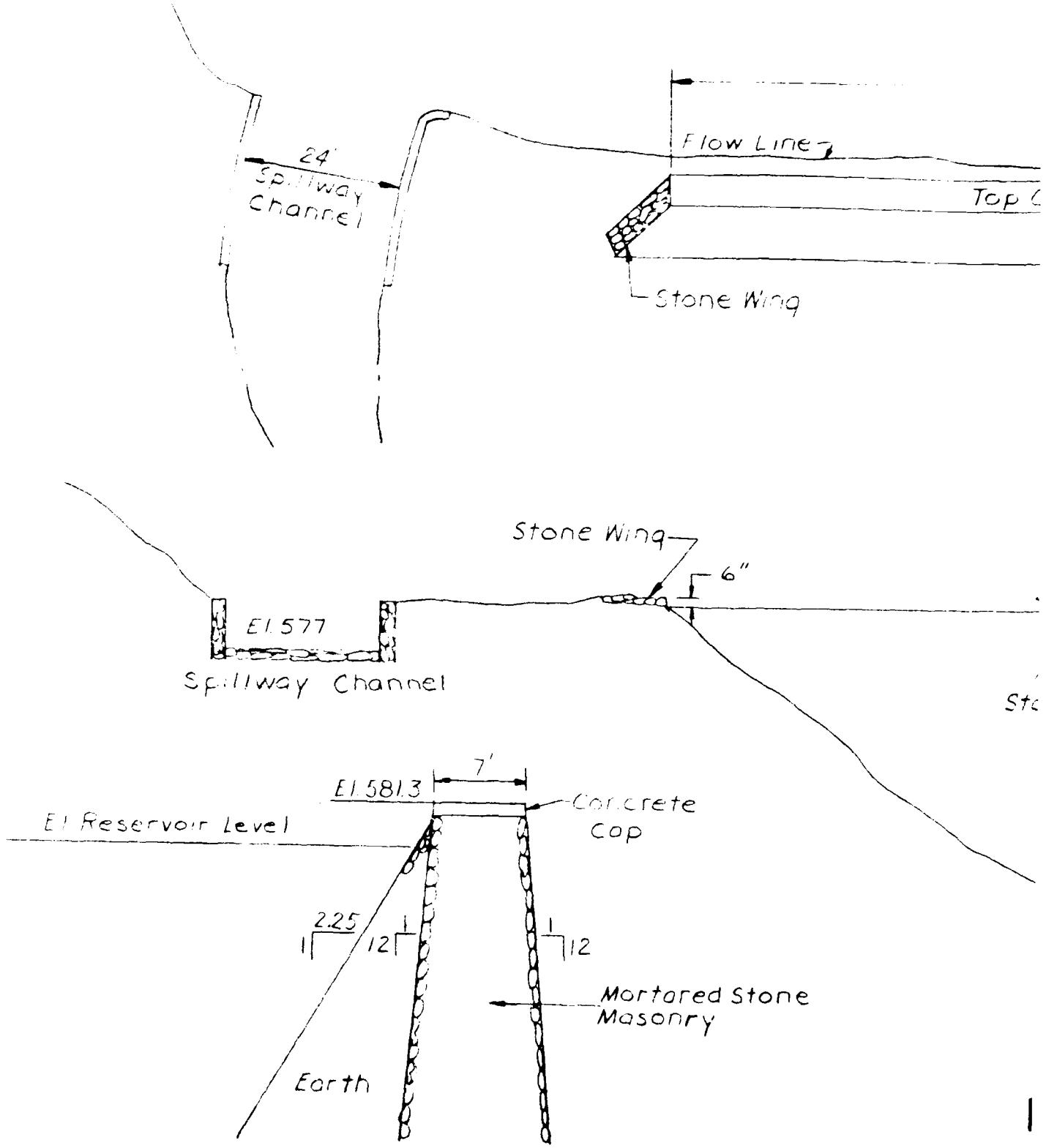
PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	N/A
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

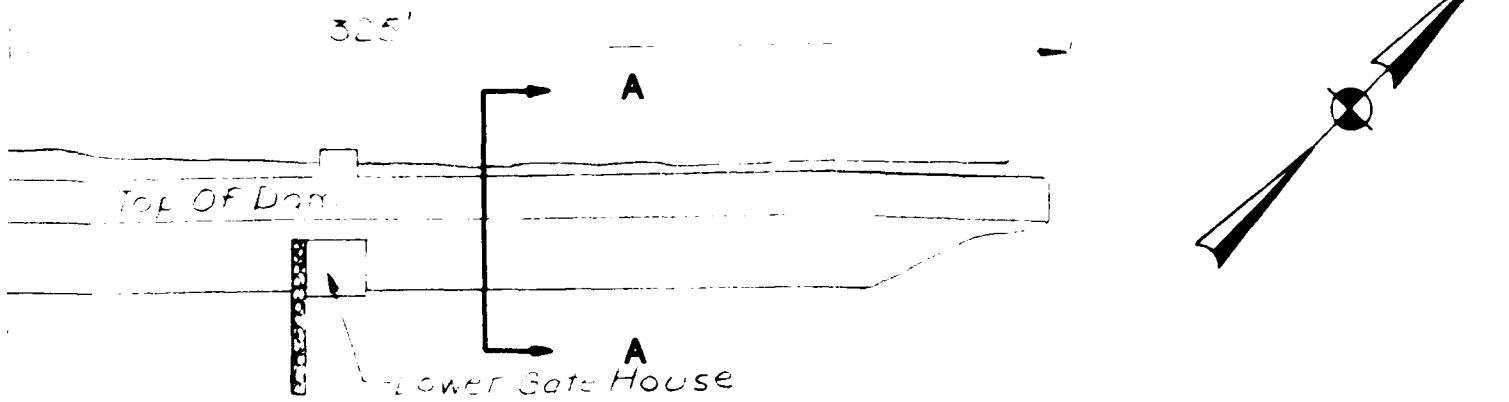
APPENDIX B

ENGINEERING DATA


24'
Spillway
Channel
Flow Line
Top
Stone Wing
Stone Wing
6"
El 577
Spillway Channel
7'
El 581.3
Concrete
Cap
El Reservoir Level
2.25
1
12
1
12
Mortared Stone
Masonry
Earth

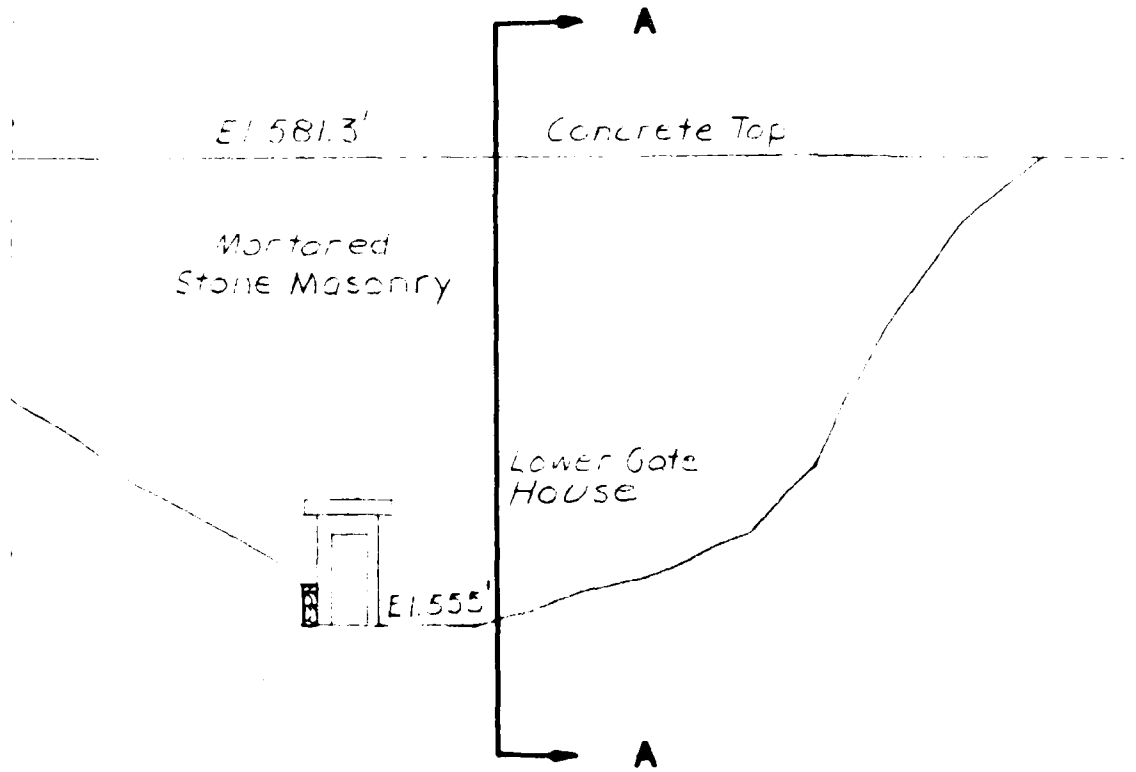
SECTION A A

PADANARAM RESERVOIR



Outlet

PLAN



ELEVATION

NOT TO SCALE

PLATE 1

STORCH ENGINEERS WETHERSFIELD CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

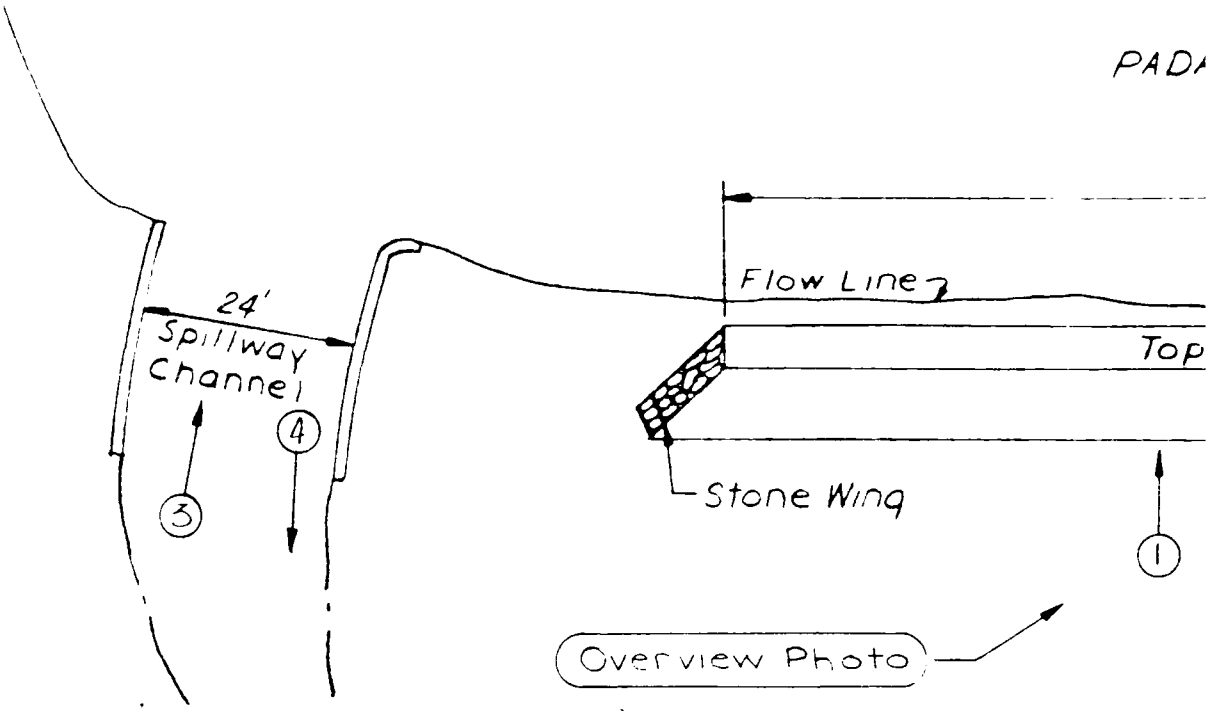
PADANARAM RESERVOIR DAM

SCALE AS SHOWN

DATE **JULY 1980**

APPENDIX C

PHOTOGRAPHS


PADA
24'
Spillway
Channel
Flow Line
Top
Stone Wing
3
4
1
Overview Photo

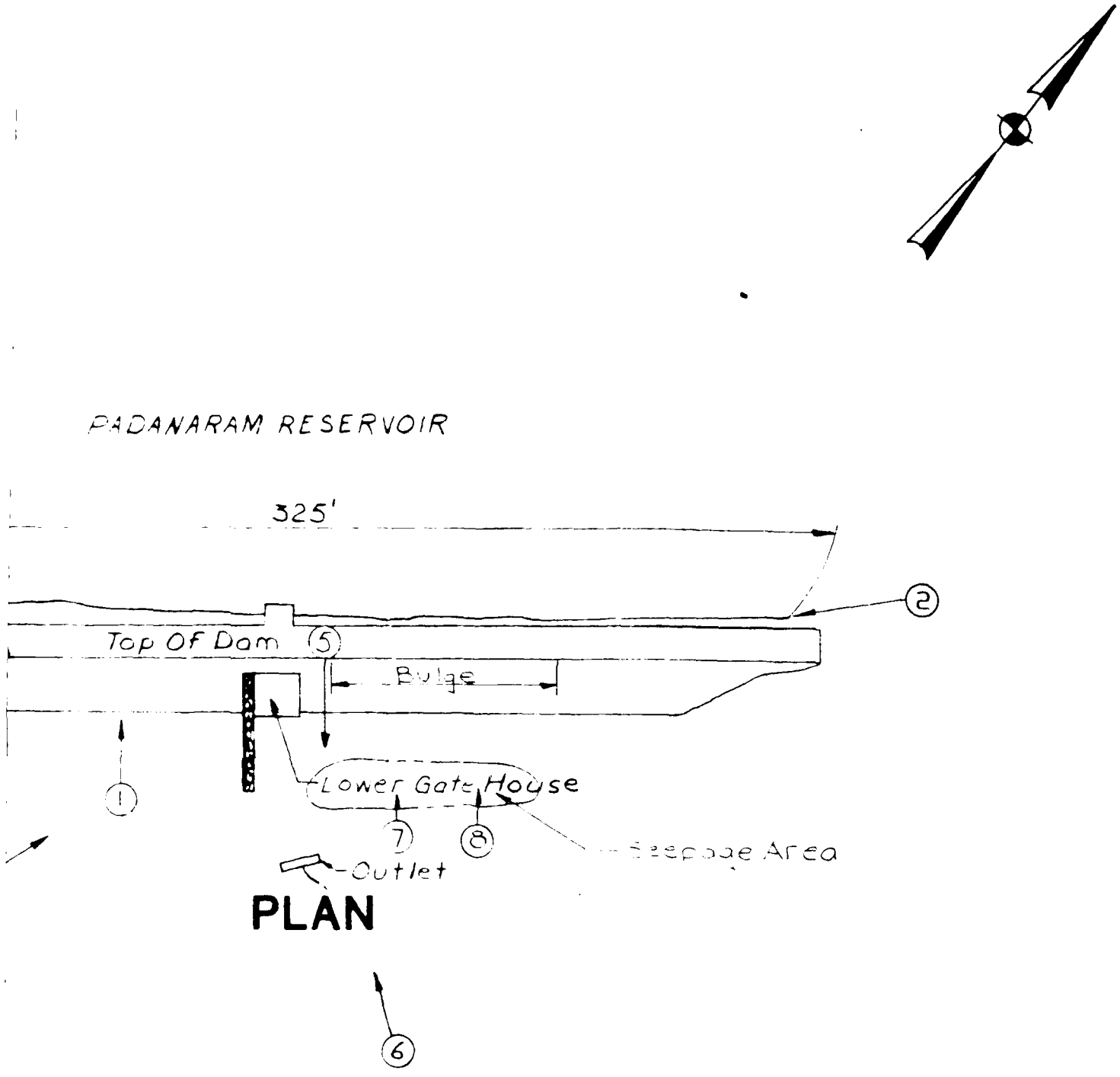


PHOTO LOCATION PLAN

PLATE 2

STORCH ENGINEERS	U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PADANARAM RESERVOIR DAM

NOT TO SCALE

SCALE AS SHOWN

DATE JULY 1980

PHOTO 2

CREST OF DAM

PHOTO 1

DOWNSTREAM FACE OF DAM

PHOTO 3

SPILLWAY-UPSTREAM

PHOTO 4

SPILLWAY CHANNEL-DOWNSTREAM

PHOTO 5

VIEW LOOKING DOWNSTREAM

PHOTO 6

LOWER GATE HOUSE & OUTLET

PHOTO 7

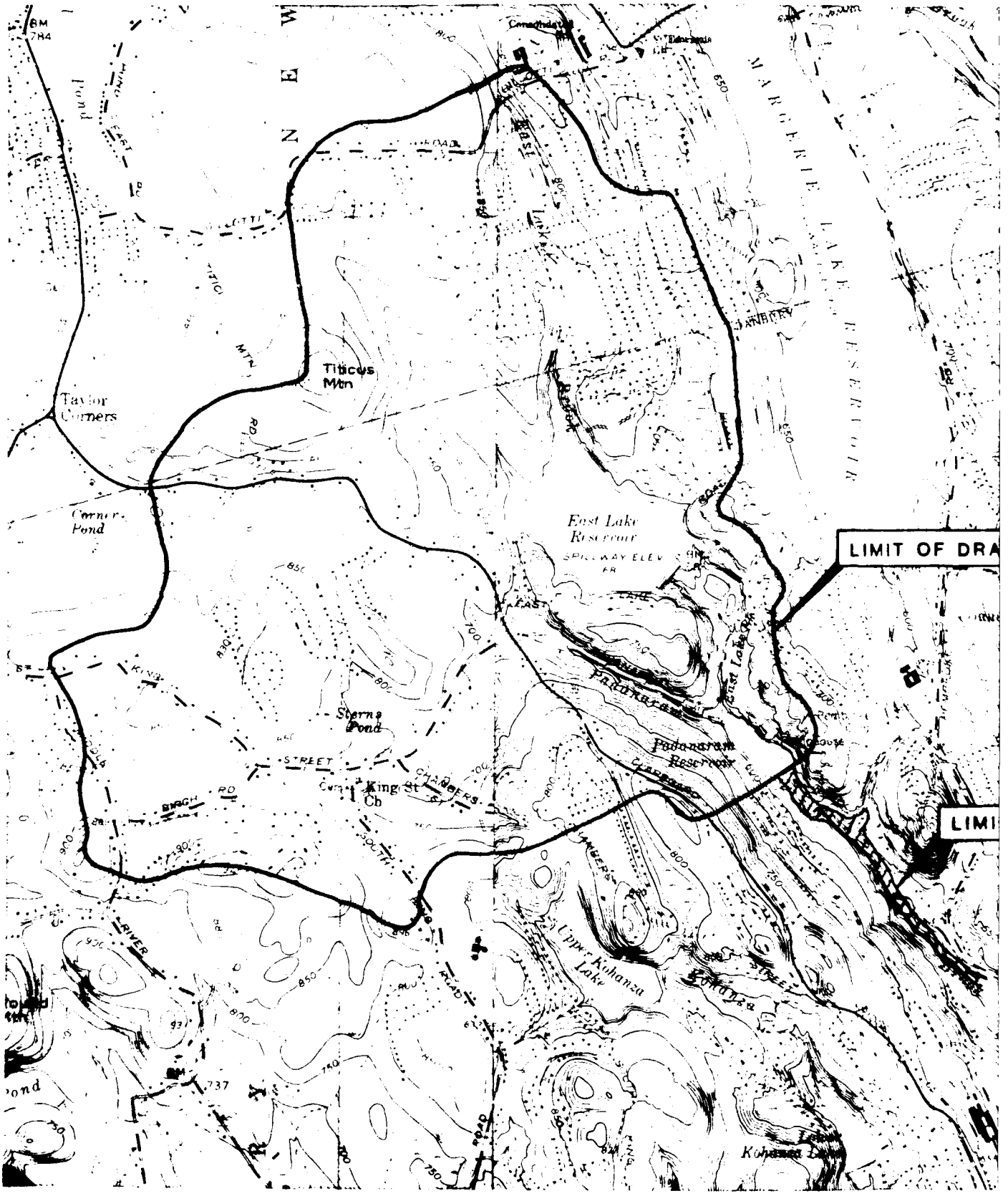
SEEPAGE NEAR TOE OF DAM

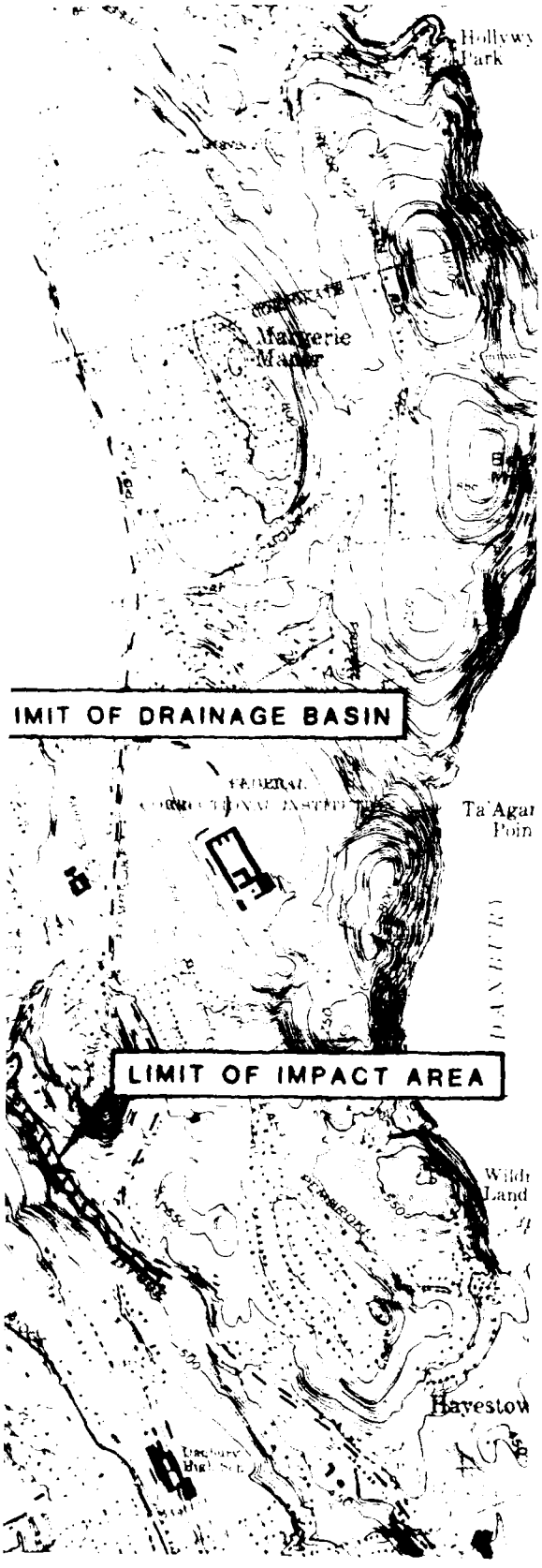
PHOTO 8

SEEPAGE NEAR TOE OF DAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS


Titicus Mtn
Taylor Corners
Corner Pond
East Lake Reservoir
LIMIT OF DRA
Padanaram Reservoir
Sterns Pond
King St
Ch
Upper Kohanza Lake
Kohanza
MARGARET LAKE RESERVOIR
JANBREV
STREET
RIVER
ROAD



scale 1:24000

PLATE 3

STORCH ENGINEERS WE[illegible] CONNECTICUT	US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PADANARAM RESERVOIR DAM

	SCALE AS SHOWN
	DATE JULY 1980

STORCH ENGINEERS
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JOB Phase I Dam Inspection - #4463
SHEET NO 1 OF 10
CALCULATED BY P A DATE 7/25/80
CHECKED BY E-C DATE 7/15/80

Determination of PMF

NAME OF DAM PADANARAM RES DAM

DRAINAGE AREA 3.7 SQ MI

INFLOW 975 CFS /SQ MI

V_2 PMF = (975 CFS/SM)(3.7 SM) = 3608 CFS

$Q_{100} = 340 \times A^{.79} = 956$ CFS

Estimating the effect of surcharge storage on the Maximum Probable Discharges

		100 YR.
1.	Q_{P1} = 3608 cfs	956 CFS
2a.	H_1 = 6.65' (elev.)	4.97'
b.	$STOR_1$ = 0.4"	0.3"
c.	$Q_{P2} = Q_{P1}(1 - STOR_1/9.5)$ = 3460 cfs	900 CFS
3a.	H_2 = 6.60 $STOR_2$ = 0.4"	4.90'; 0.3"
b.	$STOR_A$ = 0.4"	0.3
	Q_{PA} = 3460 CFS	900 CFS
	H_A = 6.6 $STOR_A$ = 0.4"	4.9'; 0.3"
	PMF = 3460 cfs	900 CFS

Capacity of the spillway when the pond elevation is at the top of the dam

Q = 600 cfs or 17 % of the PMF

67 % OF 100 YR

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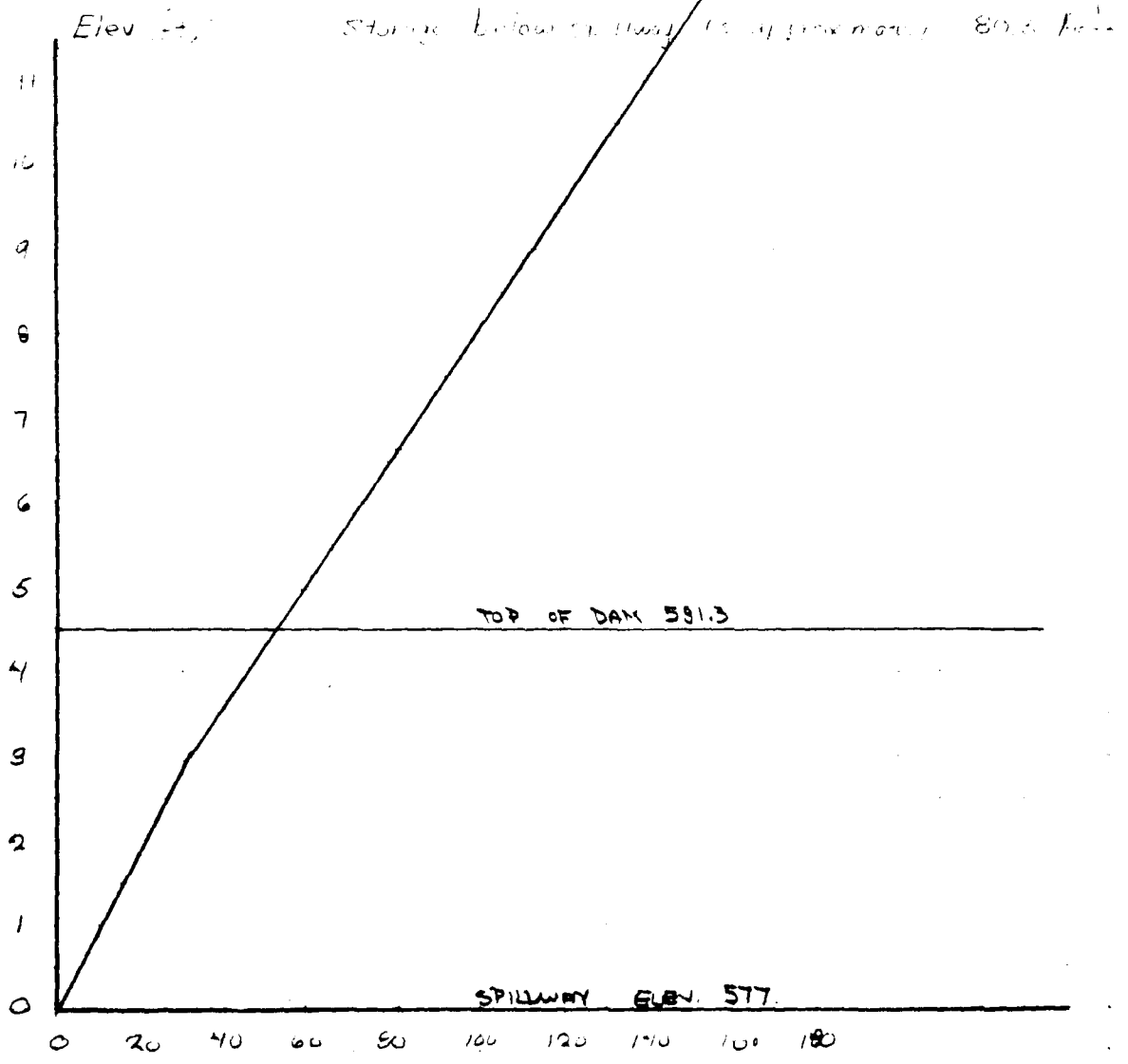
JOB Phase I Dam Inspection 4463
SHEET NO 2 OF 6
CALCULATED BY GJG DATE 4/10/80
CHECKED BY BDC DATE 7/15/80

AREA - CAPACITY

Name of Dam: PADANARAM RES. DAM

ELEV	DEPTH	AREA	AVG. AREA	VOL	Σ VOL
0		9.18			0
	3.0		10.5	31.5	
3.0		11.9			31.5
	10.0		13.5	135.0	
13.0		15.6			166.5



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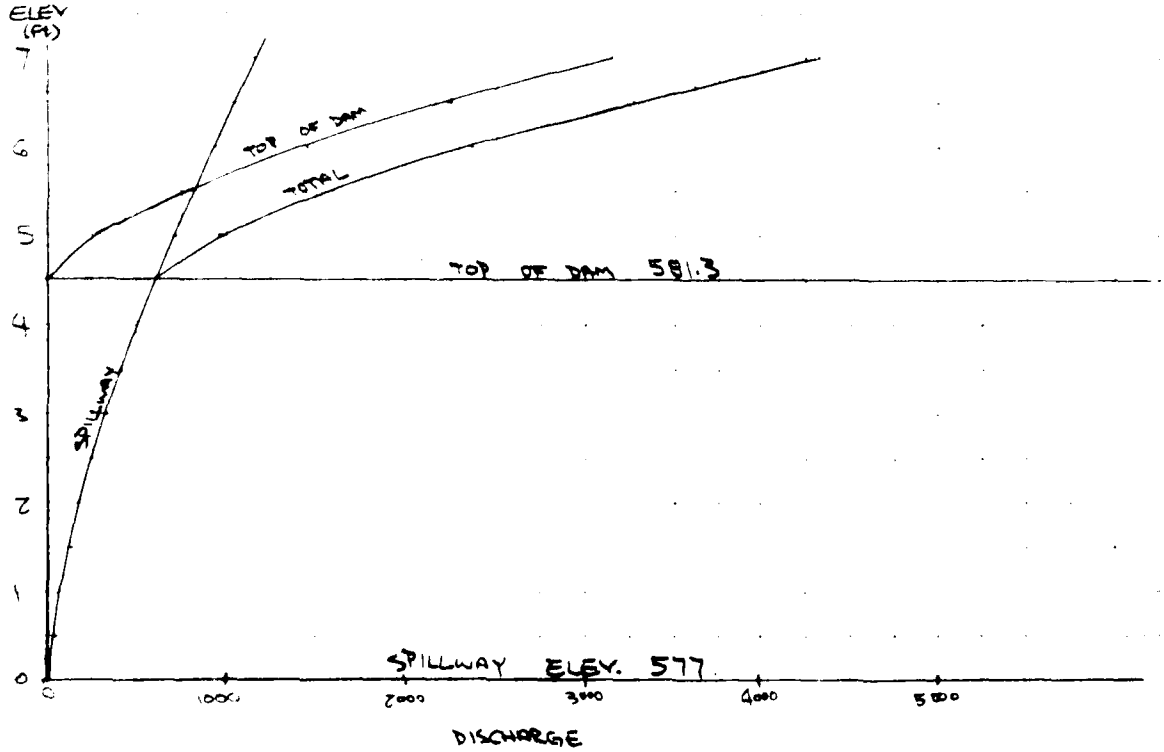
JOB Phase I Dam Inspection 4463
SHEET NO 3 OF
CALCULATED BY T A DATE 4/25/80
CHECKED BY E DC DATE 7/12/80
SCALE Stage Discharge

NAME OF DAM PADANARAM RES. DAM

$Q = CLH^{3/2}$

	Spillway I				Spillway II				Dam				
Elev	C	L	H	Q	C	L	H	Q	C	L	H	Q	QT
	2.70	24	0.5	23									23
	2.63	24	1.0	63									63
	2.63	24	1.5	116									116
	2.63	24	2.0	179									179
	2.63	24	2.5	250									250
	2.63	24	3.0	328									328
	2.63	24	3.5	413									413
	2.63	24	4.0	505									505
	2.63	24	4.5	603									603
	2.63	24	5.0	706					2.65	300	0.5	281	987
	2.63	24	5.5	814					2.65	300	1.0	795	1609
	2.63	24	6.0	928					2.65	300	1.5	1461	2389
	2.63	24	6.5	1046					2.65	300	2.0	2249	3296
	2.63	24	7.0	1169					2.65	300	2.5	3143	4312



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JOB Phase I Dam Inspection - #4463
SHEET NO 41 OF 43
CALCULATED BY P.A. DATE 9/28/80
CHECKED BY RSC DATE 7/15/80

Downstream Hydrographs

"Rule of Thumb" Guidance for Estimating Downstream Failure Hydrographs

NAME OF DAM PADANARAM RES. DAM

Section I at Dam

1. $S_1 = \frac{132}{}$ Acft
2. $Q_{P1} = 8/27\ W_b \sqrt{g}\ Y^{3/2} = (8/27)(54')\sqrt{32.2'/sec^2}\ (20.3)^{3/2} = 19050$ cfs
3. See Sections

Section II at

4a. $H_2 =$ 11.4' $A_2 =$ 1150 $L_2 =$ 800 $V_2 =$ 21.1 Acft

b. $Q_{P2} = Q_{P1}(1-V_2/S) =$ 16,400 cfs

c. $H_2 =$ 10.5' $A_2 =$ 1000 SF

$A_A =$ 1075 SF $V_2 =$ 19.7 Acft

$Q_{P2} = 19250(1-19.7/132) = 16200$ cfs

Section III at

4a. $H_3 =$ 12.5' $A_3 =$ 1350 SF $L_3 =$ 1000' $V_3 =$ 30.9 Acft

b. $Q_{P3} = Q_{P2}(1-V_3/S) =$ 11740 cfs

c. $H_3 =$ 11.0' $A_3 =$ 1080 SF

$A_A =$ 7215F $V_3 =$ 27.9 Acft

$Q_{P3} = 16200(1-27.9/112.3) = 12175$ cfs

Section IV at

4a. $H_4 =$ 12.2' $A_4 =$ 1500 SF $L_4 =$ 1000' $V_4 =$ 34.4 Acft

b. $Q_{P4} = Q_{P3}(1-V_4/S) =$ 7210 cfs

c. $H_4 =$ 9.7' $A_4 =$ 1000 SF

$A_A =$ 1250 SF $V_4 =$ 28.7 Acft

$Q_{P4} = 12175(1-28.7/84.4) = 8035$ cfs

Downstream Hydrographs (Continued)

Section V at

4a. H_5 = 10.2' A_5 = 1120 SF L_5 = 7100' V_5 = 28.3 Acft

b. $Q_{P5} = Q_{P4}(1-V_5/S)$ = 3952 cfs

c. H_5 = 7.2' A_5 = 600 SF

A_A = 860 SF V_5 = 21.7 Acft

$Q_{P5} = 8035(1-21.7/55.7) = 4900$ cfs

Section VI at

4a. H_6 = 7.0' A_6 = 900 SF L_6 = 750 V_6 = 15.5 Acft

b. $Q_{P6} = Q_{P5}(1-V_6/S)$ = 2660 cfs

c. H_6 = 4.5' A_6 = 500 SF

A_A = 700 SF V_6 = 12.0 Acft

$Q_{P6} = 4900(1-12/34) = 3170$ cfs

Section VII at

4a. H_7 = 5.5' A_7 = _____ L_7 = _____ V_7 = _____ Acft

b $Q_{P7} = Q_{P6}(1-V_7/S)$ = _____ cfs

c. H_7 = _____ A_7 = _____

A_A = _____ V_7 = _____ Acft

Q_{P7} =

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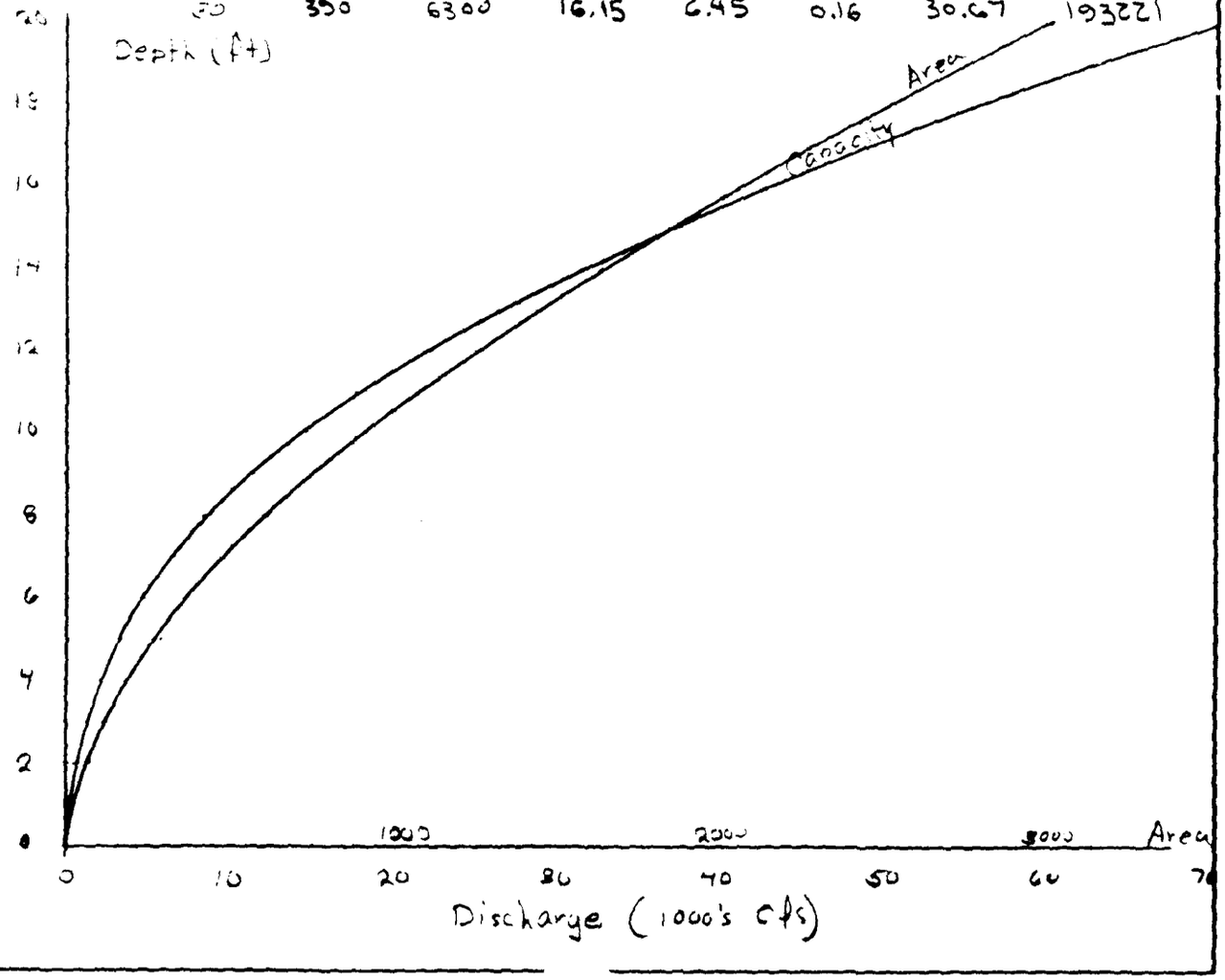
JOB
SHEET NO 6 OF 10
CALCULATED BY EAM DATE 5/8/90
CHECKED BY EEC DATE 7/10/90
SCALE Sector I

n = .05
s = 2.65 %

D	WP	A	R	$R^{2/3}$	$S^{1/2}$	V	Q
2	90	70	1.75	1.45	0.16	6.90	483
5	85	288	3.39	2.27		10.79	3108
8	120	600	5.00	2.94		13.98	8388
10	150	900	6.00	3.32		15.79	14211
20	265	2950	11.13	5.03		23.92	70569
30	350	6300	16.15	6.45	0.16	30.67	193221



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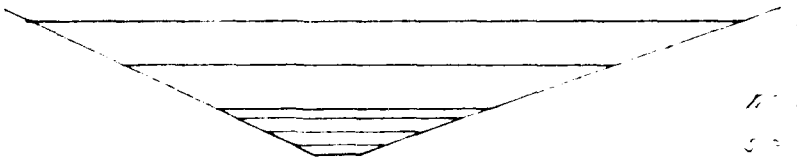
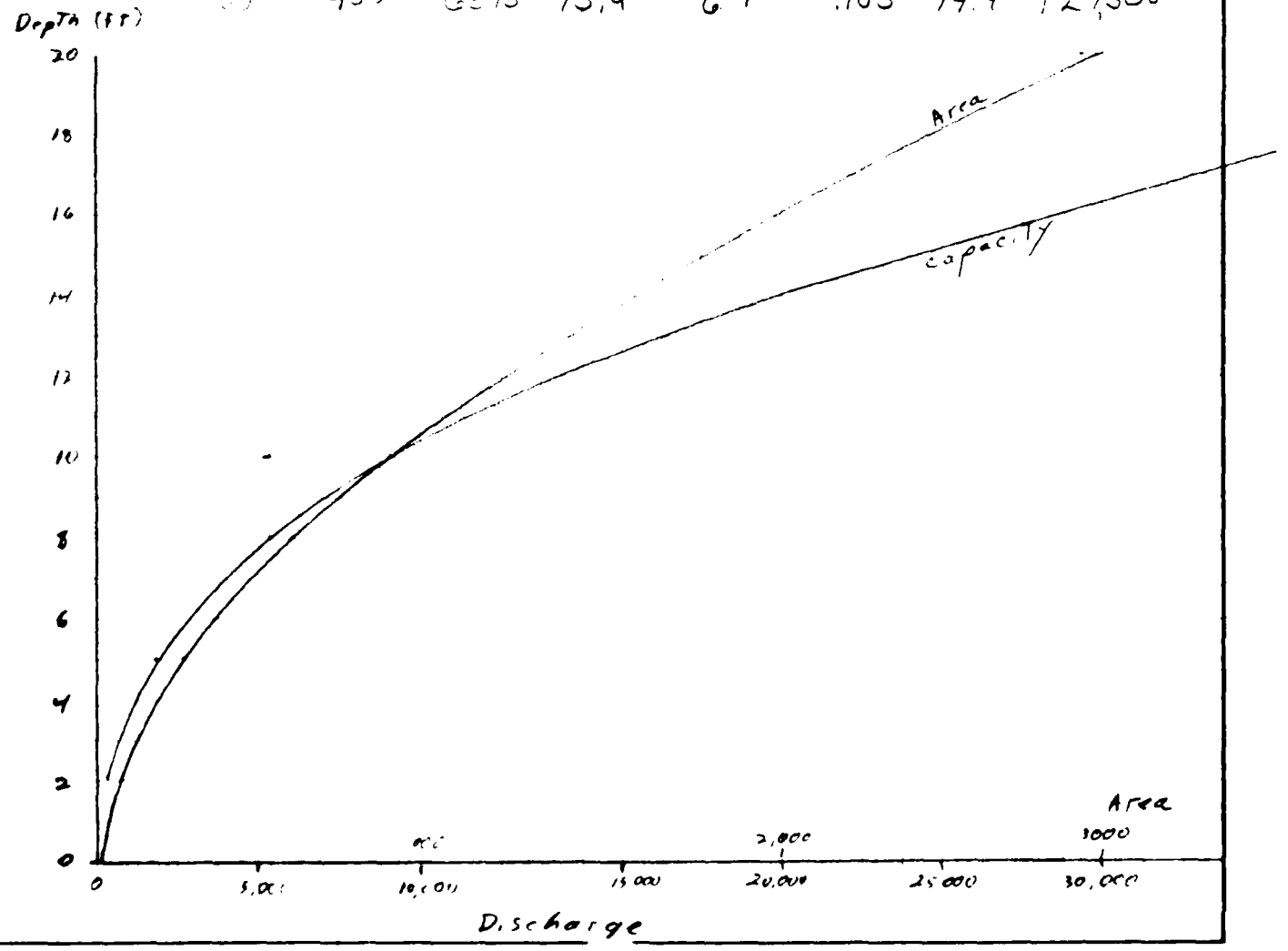
JOB 4463
SHEET NO. 7 OF 9
CALCULATED BY BAM DATE 5/30/80
CHECKED BY BEC DATE 7/15/80
SCALE Sector



D	W	A	R	R^2/3	S^1/2	V	Q
2'	50	75	1.5	1.3	.105	4.1	307
4'	95	275	3.2	2.2	.105	6.8	1890
6'	125	600	4.8	2.86	.105	8.9	5370
8'	155	900	5.8	3.2	.105	10.1	9150
10'	290	2050	10.8	4.95	.105	15.4	47270
12'	400	3375	15.9	6.4	.105	19.9	127500



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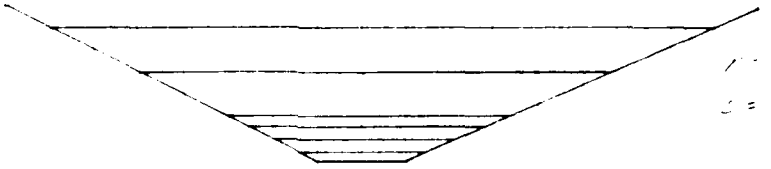
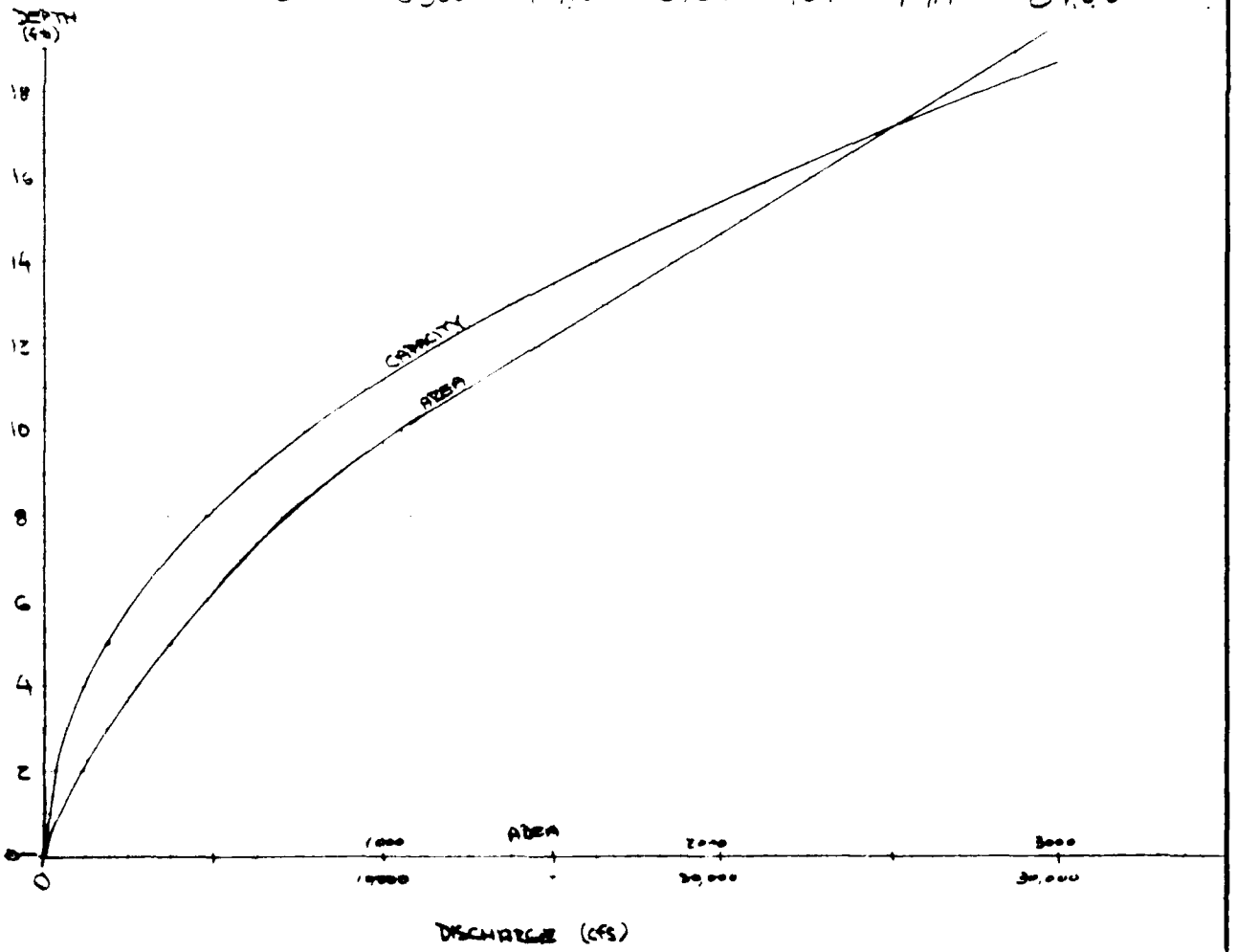
JOB 1703
SHEET NO 5 OF 10
CALCULATED BY GAH DATE 5/29/90
CHECKED BY BDC DATE 7/15/90
SCALE Sector III & IV



n = .035
S = 0.5 %

D	k	A	A	A²	S²	V	Q
2	70	120	1.71	1.4	.07	3.0	360
3	90	375	3.75	2.4	.07	5.1	1910
4	130	720	5.5	3.4	.07	6.65	4790
5	160	1050	6.6	3.5	.07	7.44	7820
6	200	3100	11.9	5.2	.07	11.1	34,125
7	370	6300	17.0	6.65	.07	14.1	89,000

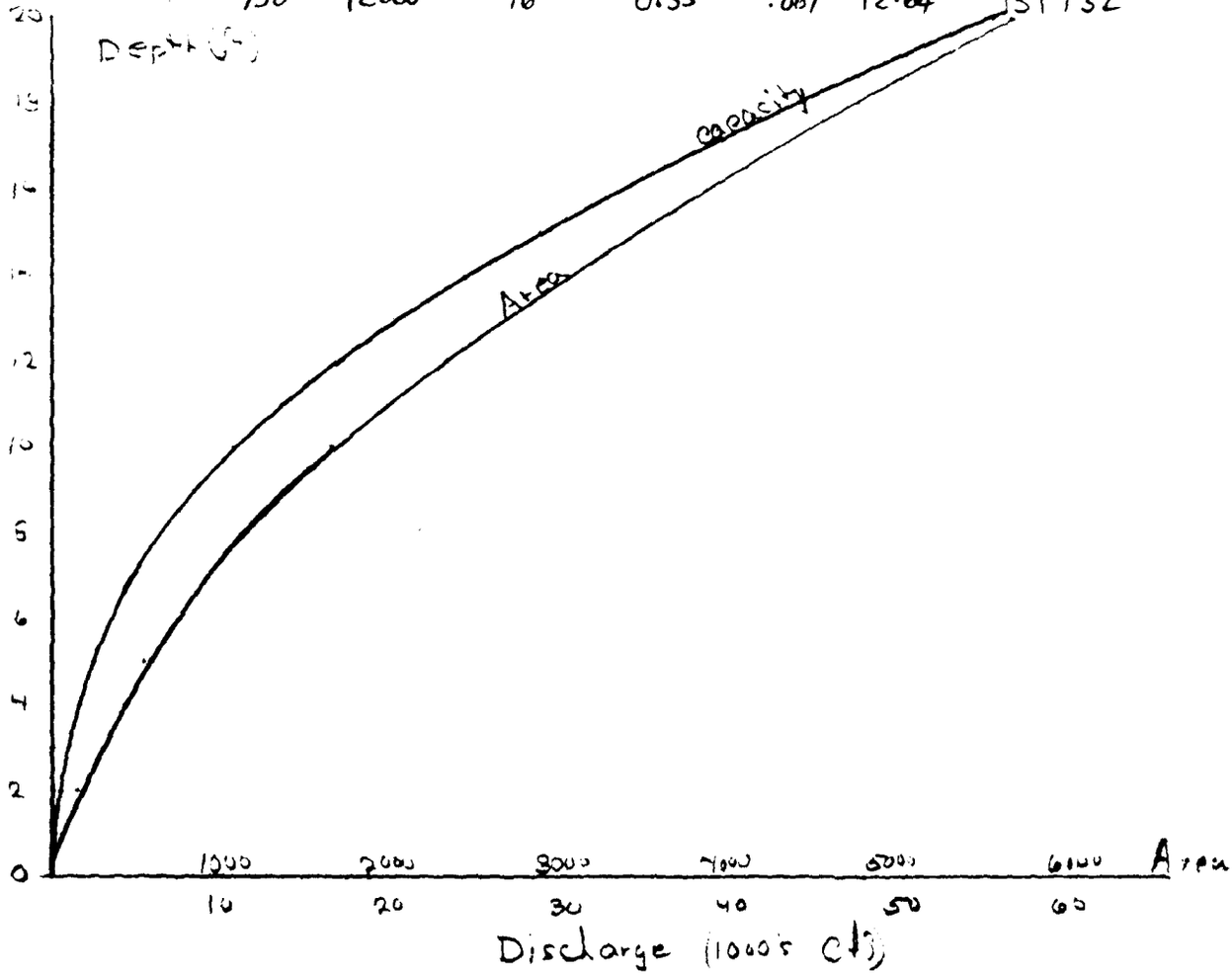


STORCH ENGINEERS/STORCH ASSOCIATES
Engineers · Landscape Architects
Planners · Environmental Consultants

JOB 41463
SHEET NO 9 OF 10
CALCULATED BY BAH DATE 5/30/90
CHECKED BY BDC DATE 7/5/90
SCALE Sector VI

n = .05
S = 3.45 %

85	135	1.59	1.36	.067	2.71	366
160	525	3.28	2.20	.061	4.38	2300
230	1120	4.87	2.87	.067	5.71	6400
280	1650	5.89	3.26	.067	6.49	10,711
510	5600	10.98	4.94	.067	9.84	55,086
750	12000	16	6.35	.067	12.64	151732



APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE NUMBER	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY	MO	YR
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	PAPANARAM RESERVOIR DAM	4129.0	7329.0	[illegible]	[illegible]	[illegible]

POPULAR NAME	NAME OF IMPOUNDMENT
	PAPANARAM RESERVOIR

RIVER BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI)	POPULATION
[illegible]	PAPANARAM [illegible]	HAVESTOWN	2	3000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT)	HYDRAULIC HEIGHT (FT)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT)	DIST	DAM	FED R	PRV/FED	SCS A	VER/DATE
[illegible]	1882	S	20	20	132	81	NED	N	N	N	N	

REMARKS

[illegible] ESTIMATE

SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT)	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PLANNED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)
[illegible]	[illegible]	24	1050	6050											

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF [illegible]	A.S. WORTHINGTON ENG.	GEORGE MCKEE CONTRACTOR

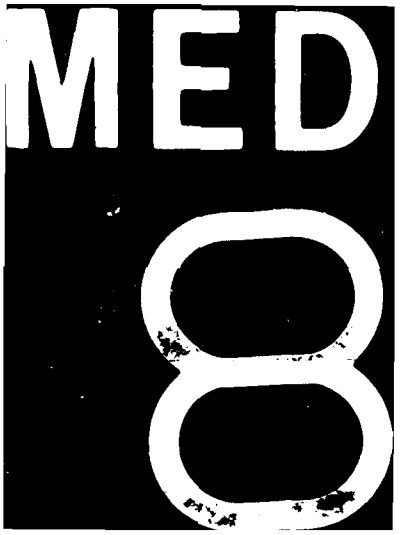
REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
		NONE	NONE

INSPECTION BY	INSPECTION DATE DAY	MO	YR	AUTHORITY FOR INSPECTION
STOCK ENGINEERS	21	APR	80	PL 92 367

REMARKS

[illegible] ESTIMATE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